11

Drosophila (DIPTERA: INSECTA) IN THE OTWAY REGION OF VICTORIA: SPECIES DIVERSITY

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Abstract: In the Otway Region as in other suitable sites west of Melbourne, there is a western extension of the adaptive radiation of the typically Australian subgenus *Scaptodrosophila*. Flies are found in permanently damp habitats characterized by tree ferns and/or sedges.

Four *Scaptodrosophila* species belonging to the same species group occur in the Otways. This species group dominates the whole of Victoria, but in eastern Victoria and southern New South Wales, many other *Scaptodrosophila* species belonging to other species groups are found also. In these regions the higher diversity of *Drosophila* is expected, since floral diversity is higher and *Drosophila* as a genus is dependent upon the vegetation as a resource.

D. (Sophophora) dispar, a widespread species, is the only other endemic Australian species found in the Otway Region.

INTRODUCTION

Carson (1971), an eminent American evolutionary biologist working in Southeastern Australia in 1961, commented that 'this part of Australia is notably depauperate in its *Drosophila*' fauna by comparison with other parts of the world where *a priori* suitable habitats for species of the genus appear to occur. Recently, following intensive field work (Bock & Parsons 1975, Parsons 1975), it has become apparent that in the rain forest/wet sclerophyll forests of Southeastern Australia there are many endemic *Drosophila* species.

Previously, as assessed from a survey of museum collections by Bock (1976), rare occurrences of *Drosophila* were reported throughout the east coast region of Australia (including Tasmania and Victoria). Bock's study comprised 81 species, including 40 that are new. Forty-five of the species belong to the subgenus *Scaptodrosophila* which is rare on a world basis (Bock & Parsons 1975). In addition, four more *Scaptodrosophila* species have been found during recent field work in Southeastern Australia, and some species previously represented by very few specimens can now be regarded as common (Parsons & Bock unpublished).

The southern Australian situation is unique in that the well-known Hawaiian adaptive radiation is in the subgenus *Drosophila* and not the typically Australian subgenus *Scaptodrosophila* (Bock & Parsons 1975). There are in fact no known species in subgenus *Drosophila* endemic to Australia. The number of Australian species now known is about one-fifth of those described in Hawaii although many Hawaiian species have yet to be described (Hardy 1974).

In this paper we relate the Otway Region *Drosophila* collections to those elsewhere in Victoria.

COLLECTING METHODS AND SITE ECOLOGIES

With rare exceptions, southern Australian flies are not attracted to conventional baits of fermented fruit or rotting mushroom. Indeed all the Otway Region flies were obtained simply by sweeping with a deep net (39 cm diam.). Many of the Otway Region habitats are characterized by tree ferns (*Dicksonia*) and other ferns. In such habitats, which are generally in sheltered locations in mountainside gullies, the highest canopy is *Eucalyptus*, though tall *Acacia* and *Nothofagus cunninghamii* may occur also (sites 1-5, and 8 in Fig. 1 and Table 1). The fern gullies yielding flies are characterized by permanent water or wet rotting on the ground. In addition, *Drosophila* has been found in permanently damp habitats characterized by sedges often at the edge of freshwater swamps and small lakes (sites 6 and 7 in Fig. 1 and Table 1).

Habitats in the Otway Region and elsewhere in Victoria which are disturbed by fire, flood, logging, or introduced plant species such as blackberries, normally have a depauperate *Drosophila* fauna. Presumably these disturbances upset the life cycle of the flies, which from evidence so far involves the larvae as

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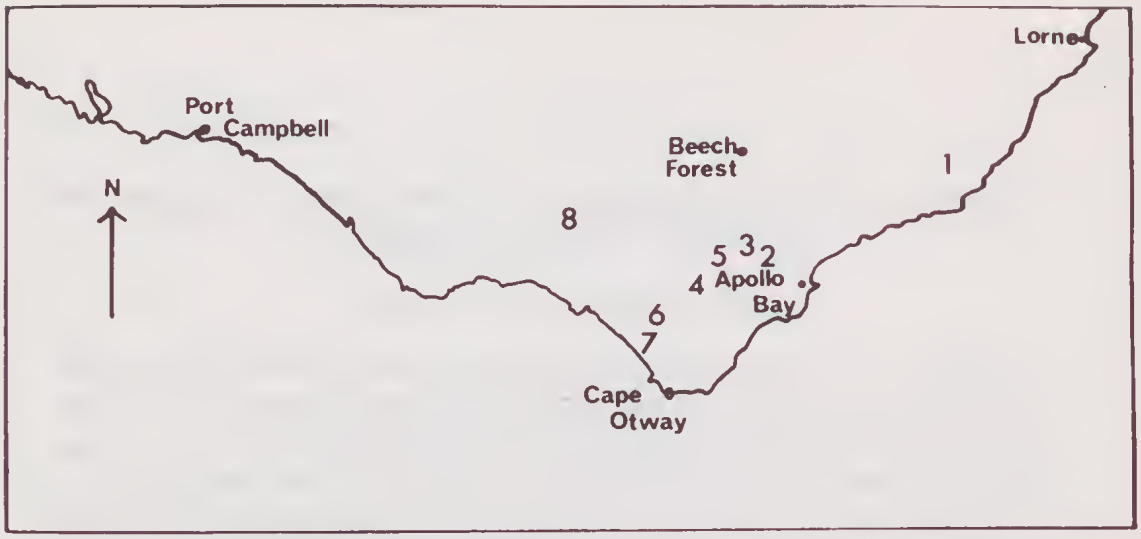

FIG. 1—Map of the Otway Region indicating the eight collection sites listed in Table 1.

miners of decomposing leaf litter followed by pupation in the soil. In other words the flies are intimately dependent on the flora as a resource, which is a feature of the genus on a world-wide basis (Carson 1971).

All species mentioned in this paper are described in Bock (1976), some for the first time. These include *D. collessi, D. rhabdote, D. barkeri, D. exemplar, D. megagenys* and *D. parsonsi*.

RESULTS

An initial late winter Otway Region collection made in September 1974 by Grossfield and Parsons (1975) consisted of four *D. (Scaptodrosophila) inornata* (1 ♂, 3 ♀♀) from Paradise Valley (site 2, Fig. 1). Subsequent summer collection records are in Table 1.

Four *Scaptodrosophila* species are listed in Table 1. Of these *D. inornata* is the commonest by far. The only exception is for site 7 which is a sedge habitat, where *D. rhabdote* predominates. It is a general feature of western Victorian collections that *D. inornata* predominates in tree fern habitats and *D. rhabdote* in sedge habitats. Table 2 gives comparative data for other western Victorian sites. *D. rhabdote* predominates in the sedge habitats of Mt. Eccles National Park

TABLE 1

SUMMED COLLECTIONS OF OTWAY REGION *Drosophila* FROM LATE 1974 TO LATE 1975

Subgenus	Sophophora		Scaptodrosophila								
Species	dispar		inornata		collessi		fuscithorax		rhabdote		Total
Site	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
1. Grey River Scenic Reserve			3	6							9
2. Paradise		2	113	57	6	7	1		1	6	193
3. Killala			10	42	1						53
4. Mait s Rest		1	73	82	1			1	3		161
5. Cape Horn			3	10							13
6. Hordern Vale Road about 1 km from Aire River.	2		1		1	1					5
7. Hordern Vale Road at Aire River.	1	2	1				1		6	18	29
8. Beauty Spot	1			1		1					3
Total	4	5	204	198	9	9	2	1	10	24	466

TABLE 2

SUMMED COLLECTIONS OF WESTERN VICTORIAN *Drosophila* FROM LATE 1974 TO LATE 1975

Subgenus	Sophophora	Scaptodrosophila					Total
Species	dispar	inornata	collessi	fuscithorax	rhabdote	parsonsi	
Mt. Eccles National Park) Tower Hill)		8			50		58
Mt. Cole Forest) Grampian Ranges)		329	10			1	340
Lerderderg Gorge) Mt. Macedon) Brisbane Ranges)		85	6		4		95
Otway Region	9	402	18	3	34		466
Total	9	824	34	3	88	1	959

and Tower Hill, *D. inornata* in the remaining sites where tree ferns are common. In Table 2, out of 959 flies collected only one, *D. parsonsi,* does not belong to the four *Scaptodrosophila* species listed in Table 1. Taxonomically, the latter four species are closely related, forming a species group (Boek 1976).

D. (Sophophora) dispar is a fifth Otway Region species not belonging to subgenus *Scaptodrosophila.* This species has not been found elsewhere in western Victoria, but is common in east coast rain forests as far north as Cairns. It is therefore the only exception to the total domination of *Scaptodrosophila* in western Victoria.

Turning to eastern Victoria (Wilson's Promontory and East Gippsland), all of the six species so far mentioned have been found in tree fern and/or sedge habitats. *D. inornata* remains dominant, but less completely so, since a number of other *Scaptodrosophila* species appear. These are *D. obsoleta, D. barkeri, D. exemplar, D. megagenys* and four species as yet undescribed, as well as *D. (Hirtodrosophila) polypori.* Of these only *D. obsoleta* belongs to the same species group as the Otway Region species. Species diversity therefore increases in eastern, as compared with western, Victoria. This appears to parallel the appearance of plant species such as the lilly-pilly, *Eugenia smithii,* which are characteristic of the rain forests of the east coast of Australia (Francis 1970). Indeed the East Gippsland flora is unique through its diversity and the presence of species not found elsewhere in Victoria (Ashton 1969). Further north, *Drosophila* species diversity from both recent collections and museum surveys (Boek 1976) is even higher. The empirical generalization that species diversities of plants and animals usually decrease with increasing latitude appears therefore to be applicable to Australian *Drosophila* (*vide* Emlen 1973). Additionally, and as already stressed, on a world-wide basis *Drosophila* as a genus is dependent upon the vegetation as a resource (Carson 1971).

DISCUSSION

The Otway Region species represent one section of an Australian adaptive radiation of the subgenus *Scaptodrosophila.* The number of species is very low compared with coastal forests to the east and north. This is almost certainly associated with greater and changing floral diversity in these latter regions. The major feature determining survival appears to be a suitable temperature/humidity regime, as found in permanently damp areas (Parsons 1975). Given the environment of Southeastern Australia, many of these suitable habitats are necessarily isolated by considerable distances (Boek & Parsons 1975), as exemplified by the Otway Region. This affords opportunity to study the *Drosophila* of 'insular islands of vegetation' on a continent as determined by suitable temperature/humidity parameters. In many cases these are marked by the presence of tree ferns in moist gullies. The 'insular islands' have probably been separated for at least 6,000 years, or since the end of an era of high precipitation, high temperature, and high rainfall (Rawlinson 1974).

There is a parallel with the populations of the Hawaiian Islands, which are isolated both between, and within islands by unsuitable climates and/or by factors such as lava flows. Suitable habitats in the Hawaiian Islands often have many *Drosophila* species, but each habitat has to some extent its own unique fauna. Temperature and humidity extremes are less frequently limiting in Hawaii in regions where flies occur than in Australia. However, there is a parallel between Hawaii and Australia, since the Hawaiian species avoid temperatures above 21°C and relative humidities below 90% (Carson et al. 1970). In South-

eastern Australia it is normally these physical boundary conditions that determine isolation given the need for permanent moisture (Parsons 1975), while in many regions in the Hawaiian Islands there is permanent moisture, but geographic features such as lava flows are important in determining isolation.

The end result in both cases is the same: an adaptive radiation in a subgenus of *Drosophila*. The Hawaiian species (subgenus *Drosophila*) are easily characterized by simply observed morphological traits; thus their taxonomy is simple. Many species, especially the large patterned/winged species are sexually highly dimorphic, with complex mating patterns. The Australian *Scaptodrosophila* are frequently difficult to separate taxonomically, since reliance on the internal male genitalia is often necessary to separate some species. Furthermore sexual dimorphism is slight or absent. The flies are mainly small, the largest so far found being about four times as large as the cosmopolitan species *D. melanogaster* though several are smaller. The Otway Region species are about the size of *D. melanogaster*.

ACKNOWLEDGMENT

PAP acknowledges the Australian Research Grants Committee for partial financial support.

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